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(54) Pipeline pig diverter or convertor

(57) Apparatus for use in subsea operations comprises a multibore connector containing an inlet (17, Figs. 2, 3, not shown) for connection to a riser or downcomer, a plurality of outlets for connection to flowlines or water injection lines, at least one diverter or convertor of curved Y-type configuration, referred to as a junction piece and piping. The piping and junction piece(s) are arranged in such manner that the inlet is connected to one junction piece where it splits into two pipes, each pipe returning directly or indirectly through further junction pieces to its outlet in the multibore connector.

The apparatus is particularly suitable for use in water flooding offshore reservoirs.

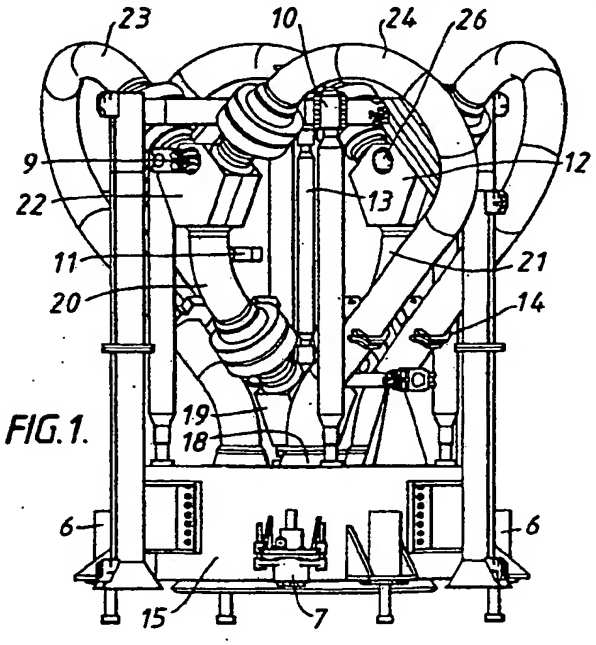

FIG.1.

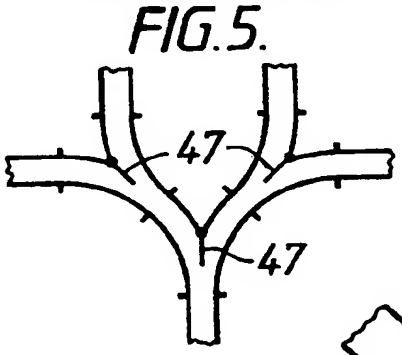

FIG.5.

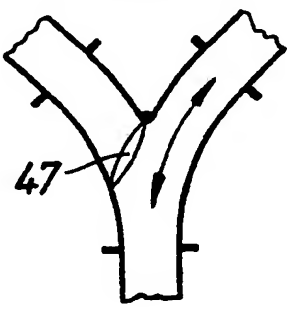

FIG.7.

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FIG. 1.

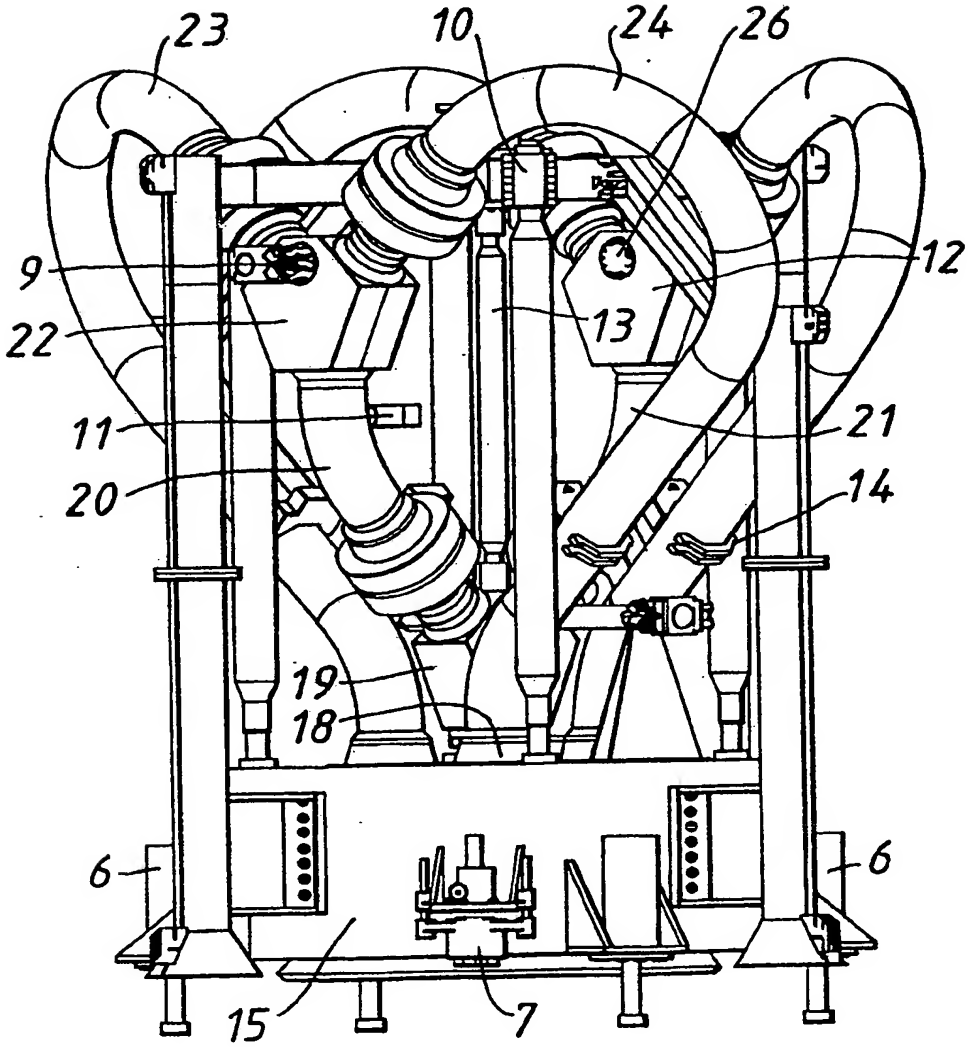

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FIG. 2.

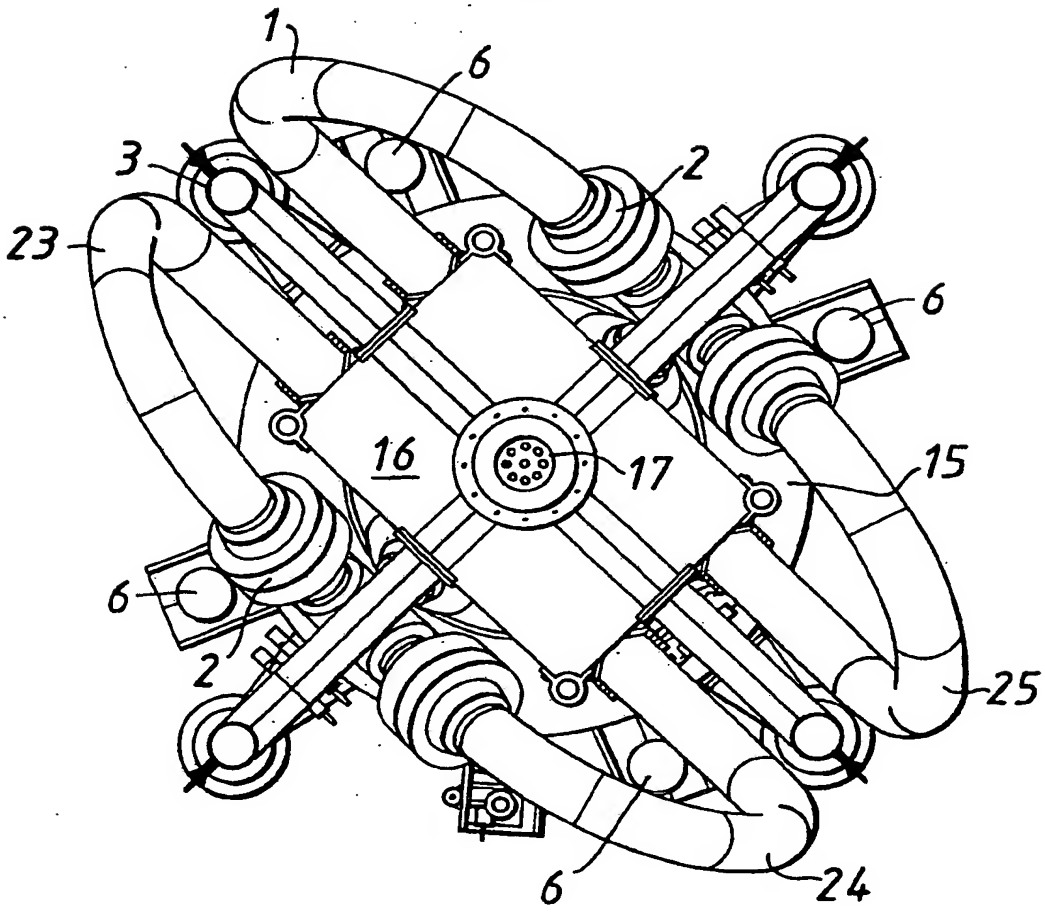

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FIG. 3.

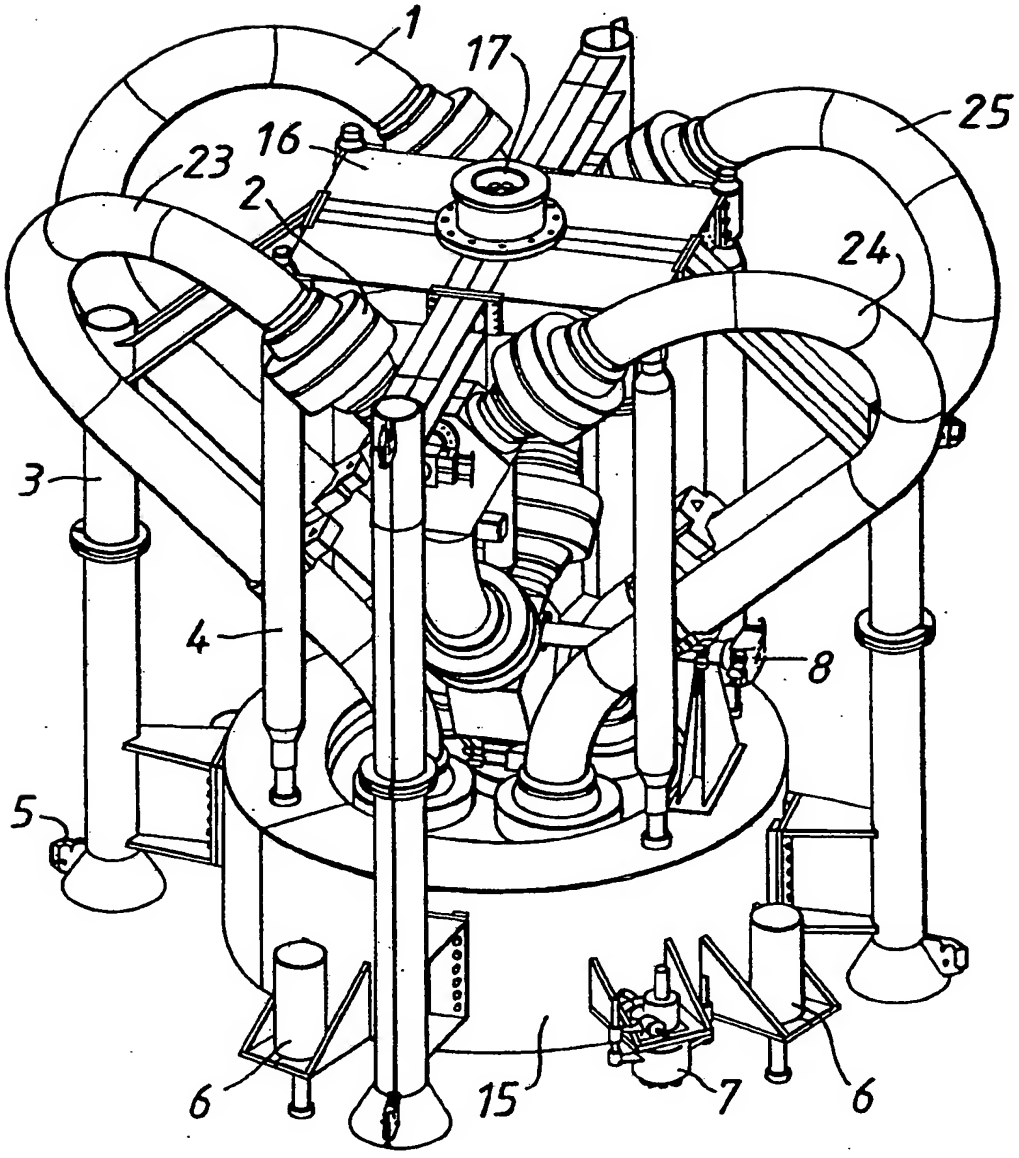


FIG. 4.

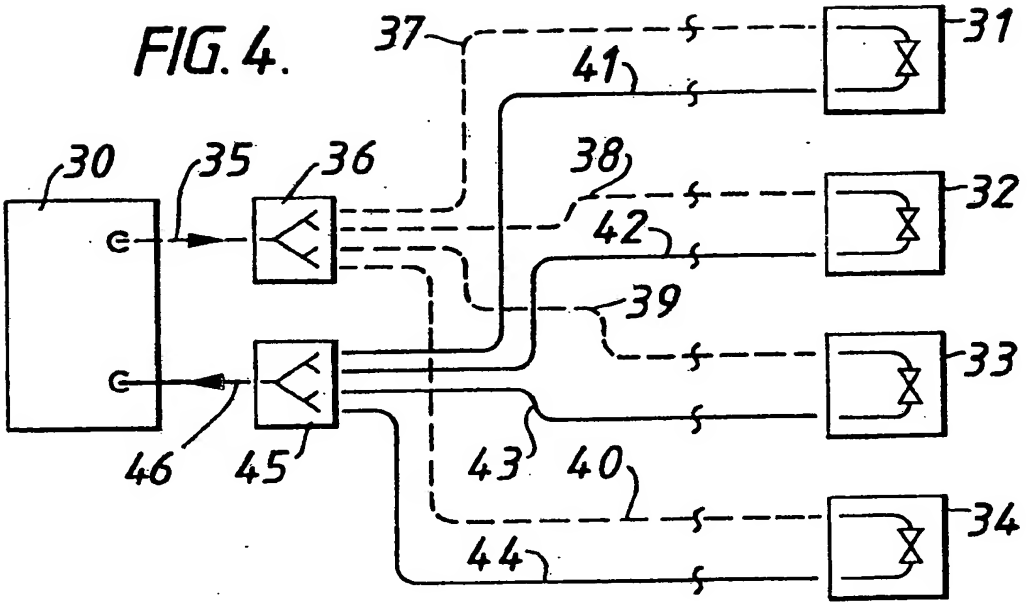


FIG. 5.

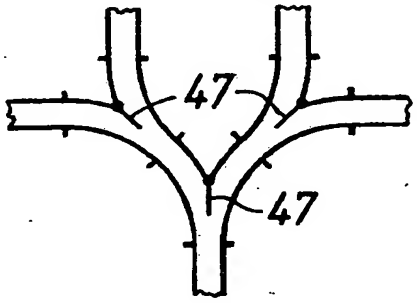


FIG. 6.

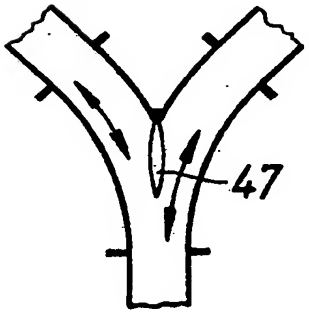
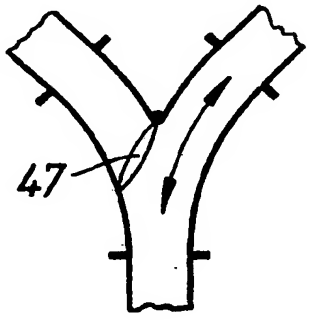


FIG. 7.



SPECIFICATION

Pipeline pig diverter or convertor

This invention relates to a pipeline diverter or convertor for splitting or combining a number of lines and to a system incorporating such equipment.

A considerable proportion of the world's remaining oil reserves is believed to lie offshore under depths in excess of 200 metres, in relatively small oil fields, and in hostile environments. As any one of these conditions intensifies, and more particularly when two or more are present together, the cost of conventional offshore recovery systems wherein drilling and production facilities are mounted on the deck of free standing platforms rises rapidly and soon becomes uneconomic.

For this reason attention has been given to subsea systems where a favoured technique is to drill a number of locational wells close together and to mount the well head control equipment on the sea bed. In order to do this, a structure known as a template is employed. In essence this is a large frame with guide tubes for drilling which is deposited on the sea bed in a desired location. After drilling, well head completion and production equipment are mounted on the frame and these facilities remain on the sea bed.

Although remotely operated vehicles (ROVs) are also known for inspecting, testing and servicing the production systems, water depths, up until now, have nearly all been such that the systems have been accessible to divers.

As the water depths in which oil is found and produced increase, totally diverless systems will be needed. Even in shallower depths, however, diverless systems could be economically attractive. It may also be necessary or desirable to dispense with guidelines, depending on the depth of the water.

Oil produced from such systems is transported by subsea pipelines either to on- or offshore facilities where it is treated for gas and water removal before being dispatched to refineries for further processing.

Production from single subsea wells or groups of wells associated with a template is delivered to the treatment facilities by pipelines of relatively small diameter known as flowlines. When the treatment and control facilities are on an offshore platform, total production is combined on the platform and exported after treatment by means of a large diameter pipeline known as the main oil line.

Sometimes the structure of an oil field is such that a number of wells and/or templates are associated with a single platform, and therefore a corresponding number of flowlines approach the platform.

A time may come in the life of an oilfield when the natural pressure of the reservoir has declined to an extent where it is no longer sufficiently large to force the oil out of the pores of the rock into the bottom of the well. This stage can be reached before the greater part of the oil has been recovered from the reservoir.

Formerly it was the practice to rely on natural drive for as long as possible, only resorting to artificial production methods when the natural pressure dropped too low to sustain a reasonable flow. However, it has now been established that the eventual recovery of oil from a reservoir can be much greater if the pressure is not allowed to drop significantly in the early stages of production. Similarly, by utilising artificial means of maintaining pressure early in the life of a reservoir, production offtake rates may often be adjusted to economic advantage.

Thus in order to maintain pressure, or to accelerate the natural drive, or to initiate a drive where none occurs naturally, it is frequently necessary to employ the technique known as secondary recovery. The simplest method of forcing the oil out of the reservoir rock is by direct displacement with another fluid. When water is used, the secondary recovery process is called water flooding.

Water flooding is one of the most successful and extensively used secondary recovery methods. Water is injected under pressure into the reservoir rock via injection wells and drives the oil through the rock into nearby producing wells.

Thus a number of water injection lines may diverge from the platform towards the wells and/or templates.

Each flowline and water injection line can reach the platform by its own individual riser and downcomer respectively, but in practice, such a multiplicitly of lines presents serious problems. Amongst these are the costs of the lines, the vulnerability of the lines, the difficulty and the cost of maintenance and, most importantly, the extra weight which the platform must bear and the space required on the platform to accommodate the lines.

It is an object of the present invention to provide a subsea diverter or convertor for diverting or converting a number of subsea lines from or to a single downcomer or riser.

Thus according to the present invention there is provided apparatus for use in for subsea operations comprising a multibore connector containing an inlet for connection to a riser or downcomer, a plurality of outlets for connection to flowlines or water injection lines, at least one diverter or convertor of curved Y-type configuration, hereafter referred to as a junction piece, and piping, the piping and junction pieces being arranged in such manner that the inlet is connected to a first junction piece where it splits into two pipes, each pipe returning directly or indirectly through further junction pieces to its outlet in the multibore connector.

It will be understood that the apparatus can be used to split a single stream into a number of streams, in which case it is termed a diverter, or, conversely, to combine a number of streams into a single stream, in which case it is termed a convertor. The mechanical features are essentially the same in each case.

Preferably three junction pieces are provided so that a single inlet is converted into four outlets.

The multibore connector is preferably of the collet type and may be operated by a mechanism comprising push rods activated by hydraulic jacks in a running tool.

The apparatus may be surrounded by a guide frame and may incorporate a hub for connection to a running tool.

The apparatus may be employed in a subsea production system in which a number of templates are supplied with water injection lines from a single platform and oil production from the templates is supplied to the platform through flowlines.

Thus according to another aspect of the present invention there is provided a production system comprising an offshore platform, a plurality of subsea templates, at least one subsea diverter as hereinbefore described and at least one subsea convertor as hereinbefore described, the arrangement being such that a single water injection downcomer from the platform is connected to the subsea diverter and split into a plurality of water injection lines for the templates and a plurality of production flowlines from the templates is combined in the subsea convertor and connected to a single production riser to the platform.

After the construction of a pipeline it is necessary to clean it out before use, for example, to remove rust, scale, sand and other contaminants. During use, deposits may form on the internal surface and, if not removed, these may build up and reduce the capacity of the pipeline.

For these duties, it is established practice to force a tightly fitting object known as a pig through the pipeline by exerting fluid pressure behind it.

Pigs may be of various configurations, depending on their intended functions. They may be cylindrical or spherical in shape.

Cylindrical pigs are frequently fitted with brushes and/or scrapers and are used for removing deposits such as wax which form on the internal surface of the pipeline. Such pigs are also fitted with cup-like washers which form a seal against the pipeline.

Spherical pigs are generally hollow, inflatable globes made from elastomeric material which are inflated with liquid to a diameter slightly exceeding the diameter of the pipeline so that they make a tight fit with the pipeline wall. They roll and turn in an unpredictable manner as they travel through the line. Spherical pigs are usually used for initial cleaning operations, for maintenance of gas lines (and also for product separation in liquid lines, although this duty is unlikely to be required in subsea flowlines).

The system according to the present invention may also be used to pig the production flowlines by dispatching the pig through the water injection system and recovering it through the production flowline system.

The invention is illustrated with reference to Figures 1 to 4 of the accompanying drawings wherein Figure 1 is an elevation of a diverter/convertor and Figures 2 and 3 are plan and isometric views respectively. Figure 4 is a schematic flowline drawing of a production system, Figure 5 is a schematic diagram of a diverter or convertor and Figures 6 and 7 are details of Figure 5 shown in different operating positions.

With reference to Figure 1 to 3.

The diverter or convertor comprises a multibore collet connector 15 having a single central inlet 18. The inlet 18 is connected to a junction piece 19 having an internal flap (not shown) to direct internal movements. Junction piece 19 has two outlet lines 20 and 21. Lines 20 and 21 are connected to two further junction pieces 22 and 12, respectively, also fitted with internal flaps. Piece 22 has two outlet lines 23 and 24 and piece 12 has two outlets 1 and 25. A typical flanged connection between a junction piece and a line is shown at 2. Lines 23, 24, 1 and 25 form curved loops which return to the multibore connector 15 where they terminate. Pig sigs 14 are provided to detect the passage of a pig.

In addition the divertor/convertor is surrounded by a guide frame 3 joined to a top structure 16 which is fitted with a hub 17 for connection to a running tool, and a tension rod 13. Guide wire The junction pieces 19, 22 and 12 are fitted with hydraulically controlled flap activators 9, 26 and 8 respectively. Line 20 is fitted with a bleed off valve 11 for controlling pressure during retrieving.

The connector 15 is activated by push pull rods 4 which are locked in position by a locking mechanism 10. It is fitted with a control pod 7 and shock absorbers 6 to provide a soft landing.

With reference to Figures 4 to 7, a production system comprises a platform 30 servicing four production templates 31, 32, 33 and 34. A water injection system is shown by the broken lines in the drawing and production flow by the full lines.

Water is injected into the injection system from a single downcomer 35 from the platform 31. The downcomer enters a diverter 36 where it is split into four streams 34, 38, 39 and 40 flowing to templates 31, 32, 33 and 34 respectively.

Production leaves template 31, 32, 33 and 34 by flow lines 41, 42, 43 and 44 respec-

tively. These flowlines enter the convertor 45 and are combined into one outlet which feeds a single production riser 46 to the platform 30.

The diverter 36 and the convertor 45 are fitted with flaps 47 as shown in Figure 5.

For normal water injection and production, flaps 47 are locked in the middle position as shown in Figure 6.

For pigging operations, a connection is made between a water injection line and a production flow line in a template by means of valves 48, 49, 50 or 51. During pigging, flaps 47 are positioned to one side for pig passage as shown in Figure 7.

CLAIMS

1. Apparatus for use in subsea operations comprising a multibore connector containing an inlet for connection to a riser or downcomer, a plurality of outlets for connection to flowlines or water injection lines, at least one diverter or convertor of curved Y-type configuration, hereafter referred to as a junction piece, and piping, the piping and junction pieces being arranged in such manner that the inlet is connected to a first junction piece where it splits into two pipes, each pipe returning directly or indirectly through further junction pieces to its outlet in the multibore connector. 2. Apparatus according to claim 1 comprising three junction pieces so that a single inlet or outlet is diverted or converted into four outlets or inlets. 3. Apparatus according to either of the preceding claims wherein the multibore connector is of the collet type. 4. Apparatus according to any of the preceding claims wherein the apparatus is surrounded by a guide frame. 5. Apparatus according to any of the preceding claims incorporating a hub for connection to a running tool. 6. A production system comprising an offshore platform, a plurality of subsea templates, at least one subsea diverter and at least one subsea convertor, the arrangement being such that a single water injection downcomer from the platform is connected to the subsea diverter and split into a plurality of water injection lines for the templates and a plurality of production flowlines from the templates is combined in the subsea convertor and connected to a single production riser to the platform.

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